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"..... per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Crateridès, ite sub undas:
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pinguì conchylia succo.
N. Parthenii Giannettasi, Ecl.

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I.—*On some Fish-remains from the Parana Formation, Argentine Republic.* By A. Smith Woodward, LL.D., F.L.S.

[Plate I.]

There is an interesting marine deposit exposed in the banks of the River Parana near the city of Parana, in the province of Entrerios, Argentine Republic. It has been known since the explorations of d'Orbigny and Darwin, and is of special importance not only as containing the remains of land-mammals itself, but also as being intimately associated with other deposits which yield abundant evidence of extinct mammalian faunas. Since marine fossils are of much more value in determining the age of a formation than the remains of land animals, this small Parana deposit may therefore be expected to afford a clue to the geological age of some of the South-American terrestrial faunas, concerning which various opinions have been expressed. Its interest in this connexion has already been recognized by several observers, including

Bravard *, Doering †, Ameghino ‡, Burmeister §, and Stelzner ‖, of whom the first three consider that its marine fossils indicate an Eocene or Oligocene age, while the two latter place the formation in the Upper Tertiary. The latest examination of its fish-remains is supposed to have proved its equivalence or homotaxy with the Eocene formations of the northern hemisphere ¶.

Fortunately a considerable number of the Parana fish-remains are the teeth of sharks, which may be supposed to have had a very wide distribution in the oceans at the time when they flourished. The evidence of geological age which they afford may thus be regarded as of considerable value. I therefore propose to record a few observations on the Elasmobranch fossils from the Parana collections in the National Museum of Buenos Aires, the La Plata Museum, and the San Paulo Museum, which have been kindly lent to me by Dr. Carlos Berg, Dr. F. P. Moreno, and Dr. H. von Jhering. The loan of these fossils has also enabled me to identify a small series of Parana fish-remains labelled by Bravard in the British Museum.

1. *Raja Agassizi*, Larrazet.

1886. *Raja Agassizii*, Larrazet, Bull. Soc. Géol. France, [3] vol. xiv. p. 259, pl. xiii. figs. 1–6.

The large dermal tubercles of an extinct skate thus described are still known only from the Parana formation. One typical specimen in the La Plata Museum measures no less than 0·088 m. by 0·075 m. across, by 0·03 m. in maximum thickness.

2. *Dynatobatis paranensis*, Larrazet.

1886. *Dynatobatis paranensis*, Larrazet, *loc. cit.* p. 263, pl. xiv. figs. 1–4.

These dermal tubercles evidently belong to a member of

* A. Bravard, 'Monografia de los Terrenos Marinos Terciarios de las Cercanias del Parana' (Parana, 1858).

† A. Doering, in Roca, 'Informe Oficial Com. Cient. Exped. al Rio Negro,' pt. iii. (1882) p. 429.

‡ F. Ameghino, 'Contribucion al Conocimiento de los Mamiferos Fosiles de la República Argentina' (1889) p. 14.

§ H. Burmeister, 'Description Physique de la République Argentina,' vol. ii. (1876) p. 219.

‖ A. Stelzner, 'Beiträge zur Geologie und Paleontologie der Argentinischen Republik,' pt. i. (1885) p. 139.

¶ G. de Alessandri, "Ricerche sui Pesci Fossili di Paraná (Repubblica Argentina)," Atti R. Accad. Sci. Torino, vol. xxxi. (1896) pp. 715–730, with plate.

the family Trygonidæ, as already observed by Jaekel*. There are two typical examples in the National Museum, Buenos Aires.

3. *Myliobatis americanus*, Bravard.

1858. *Myliobates americanus*, A. Bravard, Monogr. Terr. Marinos Terc. Parana, p. 53.
1896. *Myliobates americanus*, G. de Alessandri, Atti R. Accad. Sci. Torino, vol. xxxi. p. 724, pl. i. fig. 6.

The best-known specimen is described and figured by Alessandri, but this is too imperfect for specific determination. It seems probable that some of the detached teeth labelled as belonging to this species are truly referable to *Rhinoptera*.

4. *Cestracion paranensis* (Alessandri).

1896. *Acrodus paranensis*, G. de Alessandri, *loc. cit.* p. 723, pl. i. fig. 5.

There are two teeth of this species in the San Paulo Museum. On careful comparison with *Cestracion* they are found to agree exactly with the larger grinding-teeth in this existing genus. There is therefore no justification for referring them to the extinct Mesozoic genus *Acrodus*.

5. *Odontaspis elegans* (Agassiz). (Pl. I. figs. 1–5.)

1843. *Lamna elegans*, L. Agassiz, Poiss. Foss. vol. iii. p. 369, pl. xl. *b*, fig. 24 (non p. 289, pl. xxxv. figs. 1–7, pl. xxxvii. *a*, figs. 58, 59).
1858. *Lamna elegans*, A. Bravard, *op. cit.* p. 52.
1858. *Lamna unicuspidens*, A. Bravard, *op. cit.* p. 52.
1885. *Lamna elegans*, F. Noetling, Abh. Geol. Specialk. Preussen u. Thüring. Staaten, vol. vi. pt. 3, p. 61, pl. iv.
1896. *Odontaspis elegans*, G. de Alessandri, *loc. cit.* p. 720, pl. i. fig. 1.
1896. *Odontaspis Hopei*, G. de Alessandri, *loc. cit.* p. 720, pl. i. fig. 2.
1899. *Odontaspis elegans*, A. S. Woodward, Proc. Geol. Assoc. vol. xvi. p. 8, pl. i. figs. 15–18.

All the teeth from Parana referred to this species are rather small, and five well-preserved specimens are represented in Pl. I. figs. 1–5. It seems impossible to distinguish them from the typical teeth of *O. elegans* from the European Eocene, but the striation of their inner face is perhaps more feebly marked than in the latter. Most of the specimens are much rolled and abraded. When their inner face is worn quite smooth they are of the form referred to *O. Hopei*, Ag., by Alessandri; when they have lost their lateral denticles they are the *Lamna unicuspidens* of Bravard, as shown by his label in the British Museum.

* O. Jaekel, 'Die Eocaenen Selachier vom Monte Bolca' (1894), p. 140.

6. *Oxyrhina hastalis*, Agassiz. (Pl. I. figs. 6–8.)

1838–43. *Oxyrhina hastalis*, L. Agassiz, *op. cit.* vol. iii. p. 277, pl. xxxiv. figs. 3–13, 15–17.
(?) 1858. *Squalus eocenus*, A. Bravard, *op. cit.* p. 51.
1881. *Oxyrhina Agassizii*, R. Lawley, Studi Comp. Pesci foss. coi viv. generi *Carcharodon*, *Oxyrhina*, e *Galeocerdo*, p. 93, pls. v.–ix. (*Oxyrhina*). [The species renamed by Lawley.]
1889. *Oxyrhina hastalis*, A. S. Woodward, Catal. Foss. Fishes B. M. pt. i. p. 385.

Several teeth in the National Museum, Buenos Aires, agree both in size and shape with the European Miocene and Pliocene teeth ascribed to this species by Lawley. A well-preserved anterior mandibular tooth is shown from the outer face and in side view in Pl. I. figs. 6, 6 *a*, while two characteristic upper teeth, the first with imperfect base, are seen, outer aspect, in figs. 7, 8.

7. *Carcharodon megalodon*, Agassiz. (Pl. I. fig. 9.)

1835–43. *Carcharodon megalodon*, L. Agassiz, *op. cit.* vol. iii. p. 247, pl. xxix.
1878. *Carcharodon gigas*, R. A. Philippi, Zeitschr. f. gesammt. Naturw. vol. li. p. 685, pl. xix.
1881. *Carcharodon megalodon*, R. Lawley, *op. cit.* p. 35, pls. vi.–xi. (*Carcharodon*).
1889. *Carcharodon megalodon*, A. S. Woodward, Catal. Foss. Fishes B. M. pt. i. p. 415.

There are two upper teeth of this species from Parana in the National Museum, Buenos Aires, one being in the Lelong collection, the other presented by Señor Don Marcos Sastre. The first is considerably the larger, and is shown of two thirds the natural size in Pl. I. fig. 9. It evidently belongs to the middle of the side of the upper jaw, and is quite unabraded. Another upper lateral tooth, from a Tertiary formation at Coquimbo, Chili, has been described by Philippi under the name of *C. gigas*, and teeth either of the same or a closely related species occur in the Patagonian formation of Chubut. The Chilian specimen was found in a deposit which has yielded teeth indistinguishable from those of the existing *Carcharodon Rondeleti* (A. S. Woodward, *loc. cit.* 1889, p. 421).

8. *Carcharias* (*Prionodon*) *obliquidens* (Bravard).

1858. *Squalus obliquidens*, A. Bravard, *op. cit.* p. 51.
1858. *Lamna amplibasidens*, A. Bravard, *op. cit.* p. 53.
1858. *Lamna serridens*, A. Bravard, *op. cit.* p. 53.

1896. *Carcharias* (*Aprionodon*) *Gibbesii*, G. de Alessandri, *loc. cit.* p. 721, pl. i. fig. 3.
1896. *Corax* aff. *falcatus*, G. de Alessandri, *loc. cit.* p. 722, pl. i. fig. 4.

The meaning of Bravard's specific names quoted above is indicated by his labels in the British Museum and in the National Museum, Buenos Aires. Two teeth in the British Museum marked *Lamna obliquidens* are upper lateral teeth of *Carcharias* (*Prionodon*); numerous specimens in the National Museum labelled *Lamna serridens* are obviously upper teeth of the same species, while other specimens labelled *Lamna amplibasidens* in both museums are for the most part, if not all, lower teeth of the same fish. The majority of the lower teeth are distinctly serrated, like the specimen erroneously referred to *C.* (*Aprionodon*) *Gibbesi* by Alessandri; but many of the smaller specimens exhibit quite smooth edges—possibly a character of immaturity*. Some of the upper teeth have been referred to *Corax* by Alessandri; but I have made sections of several examples identical in shape with that represented in his fig. 4, and found all to have a central cavity. I therefore regard his determination of *Corax* from the Parana formation as a mistake.

9. *Galeocerdo aduncus*, Agassiz. (Pl. I. figs. 10, 10 *a*.)

1835–43. *Galeocerdo aduncus*, L. Agassiz, *op. cit.* vol. iii. p. 231, pl. xxvi. figs. 24–28.
1889. *Galeocerdo aduncus*, A. S. Woodward, Catal. Foss. Fishes B. M. pt. i. p. 444.

Like those of *Carcharias* the species of *Galeocerdo* are difficult to determine, but the tooth from Parana represented in Pl. I. figs. 10, 10 *a*, seems to belong to the side of the jaw of the European and North-American Miocene species *G. aduncus*. It is readily distinguished from the Eocene *G. latidens* by its deeper crown and finer serrations.

10. *Hemipristis serra*, Agassiz. (Pl. I. figs. 11, 11 *a*.)

1835–43. *Hemipristis serra*, L. Agassiz, *op. cit.* vol. iii. p. 237, pl. xxvii. figs. 18–30.
1889. *Hemipristis serra*, A. S. Woodward, Catal. Foss. Fishes B. M. pt. i. p. 449.

This species is rare in the Parana formation, but a few well-preserved upper teeth are unmistakable. The best specimen, not in the least abraded, is shown in Pl. I. figs. 11, 11 *a*. It is in all respects a typical upper tooth.

* A. Günther, Catal. Fishes B. M. vol. viii. (1870) p. 357.

11. *Undetermined Siluroids &c.*

Remains of Siluroid fishes are very abundant in the Parana formation, but all the known specimens are too fragmentary for exact determination. They evidently represent *Arius*, *Pimelodus*, *Platystoma*, and other genera which still live in the fresh waters of South America.

Fragments of Characinoids also occur and are easily recognized; but other remains, such as those which have been referred to Sparoids and Labroids by Bravard and Alessandri, are not satisfactorily determinable. The so-called tooth of *Lepidosteus* described by Alessandri (*loc. cit.* p. 726, pl. i. fig. 8) is not sufficient to indicate the presence of this genus.

If the foregoing determinations of the fish-remains from the Parana formation be accepted, it is evident that Alessandri's argument for the Eocene age of this deposit has no foundation in fact. The so-called teeth of *Acrodus* and *Corax* (which are typically Mesozoic genera) become, on renewed examination, evidence of *Cestracion* and *Carcharias*, which range throughout the Tertiary formations and survive at the present day. It is by no means certain that the teeth determined as *Odontaspis elegans* in the Parana collection belong to the same fish as those originally thus named in European Eocene collections; and even if *Carcharias* (*Aprionodon*) *Gibbesi* were correctly identified, the Phosphates of South Carolina, from which the type specimens of that species were obtained, seem to include fossils of all Tertiary ages from the Eocene to the Pleistocene. In fact, the only species in the Parana collection which seem to be of real importance for stratigraphical purposes are *Oxyrhina hastalis*, *Carcharodon megalodon*, and *Hemipristis serra*. All these in Europe are exclusively Miocene and Pliocene fossils, while the only teeth from the undoubted Eocene of North America (Alabama) commonly referred to the same species are comparatively small, not of typical size like those from Parana. Moreover, it is to be noted that several teeth of *Oxyrhina hastalis* and *Carcharodon megalodon* were dredged from the bed of the South Pacific Ocean by the 'Challenger' expedition *, this discovery probably implying that these great sharks did not become extinct until quite the latest geological times. I therefore conclude, with Burmeister and Stelzner, that the

* J. Murray and A. Renard, "Deep-sea Deposits" ('Challenger' Reports, 1891), pls. v., vi.

Parana formation is truly of late Tertiary age, and may probably be correlated with the Pliocene of the northern hemisphere.

EXPLANATION OF PLATE I.

Teeth of Elasmobranch fishes from the Parana formation, Province of Entrerios, Argentine Republic.

Figs. 1, 1 *a*. *Odontaspis elegans*, Ag.; outer and lateral aspects.
Fig. 2. Ditto; inner face.
Figs. 3, 3 *a*. Ditto; inner and lateral aspects.
Figs. 4, 5. Ditto; inner face.
Figs. 6, 6 *a*. *Oxyrhina hastalis*, Ag.; outer and lateral aspects.
Figs. 7, 8. Ditto; outer face.
Fig. 9. *Carcharodon megalodon*, Ag.; outer face, two thirds nat. size.
Figs. 10, 10 *a*. *Galeocerdo aduncus*, Ag.; outer and inner faces.
Figs. 11, 11 *a*. *Hemipristis serra*, Ag.; outer and inner faces.

The original specimens are in the National Museum, Buenos Aires, and all the figures except no. 9 are of the natural size.

II.—*The New Mexico Bees of the Genus* Megachile *and a new* Andrena. By T. D. A. Cockerell, Professor of Entomology, New Mexico Agricultural College.

Megachile Wootoni, Ckll., 1898.

The type was a male. I have before me two females from the Rio Ruidoso, about 6900 feet, at flowers of *Verbascum thapsus*, July 23 (*C. H. T. Townsend*). They differ at once from the female of *M. calogaster* by having little or no black hair on the vertex and mesothorax; one has the orange scopa as in *calogaster*, but the other has the scopa orange in the middle and black at the sides, thus approaching *M. melanophæa*.

This belongs to the subgenus *Megachile* s. str., as restricted by Friese.

Megachile sapellonis, sp. n.

♀.—Length 17–22 millim., the shorter examples having the abdominal segments retracted.

Black, with rather thin pubescence, white on sides of face, cheeks, pleura, metathorax, femora, sides of first segment of abdomen, and hind margins of second and following segments, more or less interrupted in the middle, at least on